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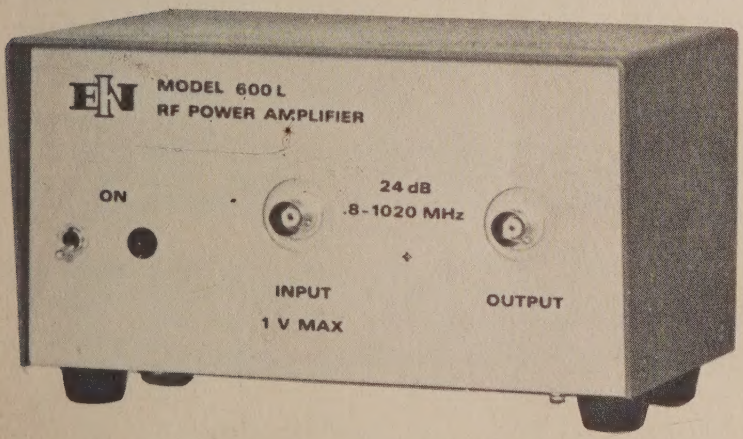
INSTRUMENTATION

ELECTRONIC NAVIGATION INDUSTRIES, INC.

INSTRUCTION MANUAL

MODEL 600L

BROADBAND POWER AMPLIFIER



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TELEX #97-8283 ENI ROC

WARRANTY

Electronic Navigation Industries, Inc. warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing and replacing any defective parts for a period of one (1) year after delivery to the original purchaser.

When warranty service is required, the instrument must be returned transportation charges prepaid to the factory or our authorized service facility. If, in our opinion, the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before work is started.

There are no other warranties expressed or implied, including any warranty of merchantibility or fitness. Seller shall not be responsible for any incidental or consequential damages arising from any breach of warranty.

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CHAPTER 1. GENERAL INFORMATION

1.1 INTRODUCTION

The Model 600L is a general purpose broadband amplifier capable of more than 150 milliwatts of linear power output when driven by any laboratory signal or sweep generator from .8 to 1020 MHz.

An ultra linear Class A design, the 600L will "boost" the output of any signal source by a flat 24 dB (± 1.5 dB) and provide its full forward output power into any load impedance (from an open to a short circuit). Its output is a faithful reproduction of the input waveform for AM, FM, SSB, CATV, pulse and other complex modulations. Although specified only over the .8 to 1020 MHz frequency range, full power output is typically available from .7 to 1050 MHz.

The use of microwave transistors on thin film substrates, microstrip circuitry, and plug-in modules make the 600L both reliable and easy to service. An integral power supply permits operation over a wide range of temperature and AC line conditions.

1.2 DATA SUMMARY

Frequency Coverage:	.8 to 1020 MHz
Gain:	24 dB Nominal
Gain Variation:	±1.5 dB
Maximum Linear Power Output:	More than 150 milliwatts
Harmonic Distortion:	All harmonics greater than 20 dB below the fundamental at 150 milliwatts output. Lower Distortion at reduced power.
Input/Output Impedance:	50 ohms
Input/Output VSWR:	1.8 Maximum
Stability:	Unconditionally stable
Typical 3rd Order Intermodulation Intercept Point:	+35 dBm
Noise Figure:	9 dB
Power Requirements:	115/230V a.c. ±12% 50-400 Hz at 12 watts

Size and Weight:	3.87 x 6.5 x 4.56 inches, 2.5 lbs. 9.8 x 16.5 x 11.8 cm, 1.1 kg.
Operating Temperature:	0° to 45° C
Protection:	Unit will withstand a +20 dB overdrive (1 volt RMS) for all output load conditions, including short and open circuits.
Output Connectors:	BNC standard, SMA and type N optional

CHAPTER 2. OPERATION

2.1 INTRODUCTION

The ENI 600L RF amplifier is used to increase the r.f. output level of signal sources in the .8 to 1020 MHz range. No tuning or any other form of adjustment is required other than the selection of the correct power supply input voltage.

The 600L produces rated power output at its output connector, regardless of load impedance. Any power reflected due to output load mismatch is absorbed in the amplifier. Therefore, although the output impedance is 50 ohms (typical VSWR: 1.5:1), the amplifier will work into any load impedance.

2.2 Mains Voltage Setting

The supply voltage selection switch is located at the rear of the instrument and is normally set for 115 V a.c. operation.

CAUTION

Before connecting the unit to the mains supply, check that the supply voltage selection switch is correctly set. Extensive damage will result if the Amplifier is connected to the wrong supply voltage. Under no circumstances should this switch be operated while the supply is connected.

2.2.1 Mains Fuse Rating

The mains fuse F1 is located on the rear panel. The replacement part number details are:

.5 amp Slow Blow ENI Part No. 313.500

The .5 amp rating is correct for both 115 and 230 volts a.c.

2.2.2 Mains Lead Connection

For 230 V a.c. operation, a suitable mains supply plug must be fitted to the mains lead attached to the instrument. The three conductors are color coded as follows:

BLACK - Live
WHITE - Neutral
GREEN - Earth

2.2.3 OPERATION

Determine and adjust the voltage setting and fuse rating as described in the previous sections 2.2 and 2.2.1 then proceed as follows:

(i) Ensure input voltage is not excessive.

The 1 V rms indicated maximum input voltage is 5 times the level of the input signal required to achieve maximum output. Input voltages in excess of 2 volts peak may permanently damage the instrument.

(ii) Connect the input signal via a 50 ohm coaxial lead and BNC plug to the input connector.

(iii) Connect the output via a 50 ohm coaxial lead and BNC plug to the load.

CHAPTER 3. TECHNICAL DESCRIPTION

3.1 GENERAL DESCRIPTION

The ENI 600L is designed to amplify signals by 24 dB in the frequency band of .8 to 1020 MHz. The signal from the front panel BNC connector is fed via a length of 50 ohm coaxial cable to the input of the amplifier module (600L - 2822). The signal from the input of the amplifier module is fed via a length of microstrip transmission line to a π network attenuator R1, R2, and R3 (see figure 5.1). The output from the attenuator is fed to the input of low noise transistor amplifier stage Q1. The output of Q1 is amplified and gain leveled by stage Q2. The output of Q2 is then impedance matched by L6 and C11 and fed to the base of output transistor Q3. The low distortion output of Q3 is also impedance matched and fed via 50 ohm coaxial cable to provide the specified 50 ohms to the output BNC connector.

The amplifier power requirements are 115 V or 230 V a.c. at 12 watts. The power unit provides a regulated 15 V d.c. 300 mA source. The 15 V d.c. source is regulated by series pass transistor Q1 and integrated circuit regulator IC1. R2 adjusts the supply to 15 volts. The light located in the front panel is of the L.E.D. type and will indicate when the power supply is operating correctly.

CHAPTER 4. MAINTENANCE

4.1 INTRODUCTION

The ENI 600L RF amplifier requires no periodic maintenance. The instrument is unconditionally stable and is failsafe under all load conditions. Damage can only be externally caused by the incorrect selection of the supply voltage or by an input signal in excess of the specified 1 volt rms maximum.

This chapter therefore, deals only with certain fundamental procedures for fault location and with the subsequent re-alignment procedures.

Performance limits quoted are for guidance only and should not be taken for guaranteed performance specifications unless they are also quoted in the Data Summary Section 1.2.

4.2 ACCESS AND LAYOUT

The ENI 600L is housed in an aluminum chassis. The cover can be removed by releasing the four #4-40 screws on the side of the unit and lifting the cover.

The lamp indicator on the front panel is of the L.E.D. type. This lamp may be replaced by applying pressure with the thumb to its lens until it is released from its plastic bezel.

The rear panel supports the mains fuseholder and the mains input selector switch (S2).

The amplifier module is mounted to the base and rear of the one piece chassis. Before removal of this module it is necessary to first remove its top cover, the coaxial cables connected to it and the appropriate lead from the terminal located on the power supply regulator module (600L - 4822).

4.3 PERFORMANCE CHECKS

To determine the amplifier's performance carry out the following procedure.

4.3.1 Initial Check

The following check can be made after repair and adjustments or whenever the condition of the unit is in question.

(i) Connect power supply. Switch on power and observe that the supply lamp (DS1) illuminates.

(ii) Connect a sweep generator (Hewlett Packard 8620C or similar) capable of sweeping the frequency range 10 to 1020 MHz to the input connector.

(iii) Adjust the output level of the sweep generator so that a 50 ohm video detector connected at the output of the unit will not be damaged by excessive power output.

(iv) Observe the gain versus frequency ripple on an oscilloscope calibrated in decibels. The gain variation must be not more than ± 1.5 dB over the frequency range.

(v) Connect a calorimetric power meter (HP434 or equivalent) through a short length of 50 ohm cable to the output connector. Adjust the input CW signal to any frequency between .8 and 1020 MHz for 150 milliwatts output.

(vi) Observe the harmonic distortion of the output on a spectrum analyzer. The harmonic components contributed by the amplifier should be at least 20 dB down from the fundamental.

If the requirements of this check are not met, verify that:

(a) The mains supply switch and fuse are correctly selected and that DS1 is illuminated.

(b) The power amplifier supply voltage is set at 15 volts by R2.

If the above checks are found to be correct, then normal fault location procedures, with reference to the circuit diagram Figure 5.1 should be followed to determine the correct operation of the amplifier module.

4.4 RE-ALIGNMENT PROCEDURE

Before any adjustment is made to the unit, first

(i) Ensure that the mains switch and fuse are correctly selected and that DS1 is illuminated.

(ii) Measure the power supply voltage and adjust per section 4.3.1(b).

4.4.1 Measurement of Gain

Equipment required:

(a) HP8620C - Sweep Oscillator
(b) HP86222A - RF Plug-in
(c) Oscilloscope - Telequipment Model S54A
(d) 50 ohm Detector - Wavetek D151
(e) Attenuator, 10 dB, 20 watts - Narda 766-10
(f) HP8601A Sweep Signal Generator

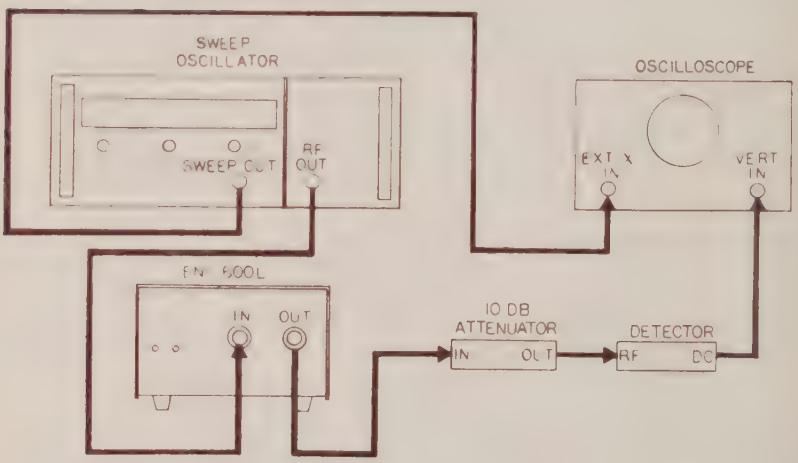


Fig. 4.1 Gain Measurement

Connect the equipment as shown in Figure 4.1, then proceed as follows:

(a) Set the oscilloscope to DC, time/CM to Ext. X, and vertical gain to 10MV/CM.

(b) Set the sweep/generator to the sweep mode with the start frequency at 10 MHz and the sweep width to 1020 MHz.

(c) Disconnect the ENI 600L from the set-up and connect the sweep/generator RF output directly to the 10 dB attenuator.

(d) Adjust the output level of the sweep/generator for full vertical deflection on the oscilloscope face.

(e) Calibrate the scope face to show 3 dB in 1 dB steps by attenuating the sweep/generator in 1 dB steps and marking the traces with a grease pencil.

(f) Return sweep/generator output level to full deflection. Rotate the step attenuator on the sweep/generator (CCW) so that the output is reduced by 24 dB.

(g) Reconnect the 600L into the test set-up of Figure 4.1.

(h) Flip the 600L power switch to the "on" position.

(i) Observe the gain versus frequency sweep on the oscilloscope.

1. The average gain should be 24 dB (within 1 dB).

2. The gain variation should be within the 3 dB markings as shown on the oscilloscope.

(j) Repeat steps (a) through (i) using the HP8601A Sweep Generator with start frequency at 800 KHz and the stop at 10 MHz.

4.4.2 Measurement of Harmonics

Equipment required:

(a) HP8620C - Sweep Oscillator
(b) HP86222A - RF Plug-in
(c) Calorimetric Power Meter - HP434A
(d) Spectrum Analyzer - HP140T Display Unit
HP8555A Spectrum Analyzer
RF Section
HP8552A Spectrum Analyzer
IF Section

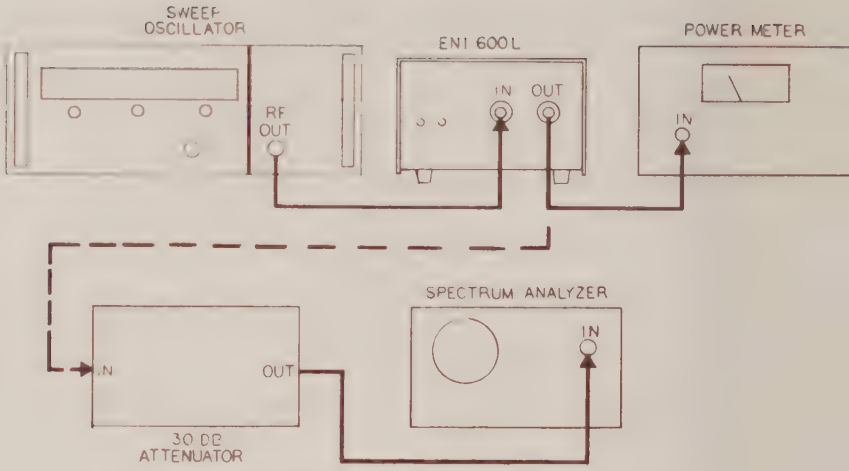


Fig. 4.2 Harmonic Measurement

Connect the equipment as shown in Figure 4.2 then proceed as follows:

(a) Adjust the sweep/signal generator at a CW center frequency of 500 MHz for an indicated output of 150 milliwatts on the power meter.

(b) Using the spectrum analyzer, check that the level of the carrier harmonics are less than -20 dB with respect to the carrier.

(c) If the above specification is not met, the 15 volt d.c. supply may be varied up to ±.5 V to reduce the harmonic level.

4.5 PACKAGING FOR RESHIPMENT

In the event of the equipment being returned for servicing it should be packed in the original shipping carton and packing material. If this is not available, wrap the instrument in heavy paper or plastic and place in a rigid outer box of wood, fiberboard or very strong corrugated cardboard. Use ample soft packing to prevent movement. Provide additional support for projecting parts to relieve these of unnecessary shock. Close the carton securely and seal with durable tape. Mark the shipping container FRAGILE to ensure careful handling.

CHAPTER 5. SCHEMATIC AND PARTS LIST

5.1 SCHEMATIC DIAGRAM

A complete schematic diagram appears in figure 5.1.

5.2 PARTS LISTS

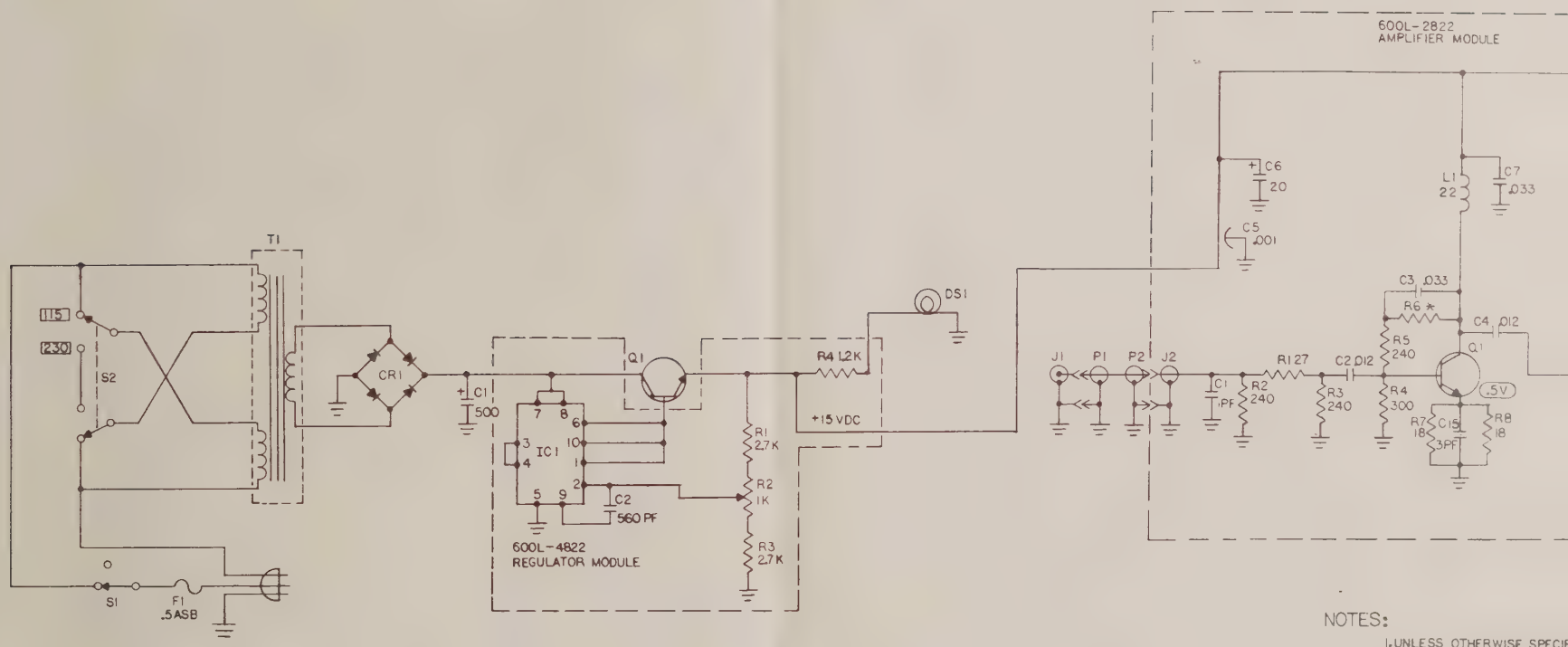
Table 5.1 provides a listing of all electrical parts and those mechanical parts which may be required for replacement. Electrical parts are listed by module number and by reference designations as indicated on the schematic diagram. Parts list includes a description, part number and manufacturers federal supply code number. Table 5.2 provides a reference glossary of abbreviations used in the parts list.

5.3 LIST OF MANUFACTURERS

Table 5.3 provides a correlation of the manufacturers federal supply code numbers used in the parts list with the names and addresses of the manufacturers. If ENI's manufacturer code number (10226) appears, that part must be obtained directly from Electronic Navigation Industries, Inc.

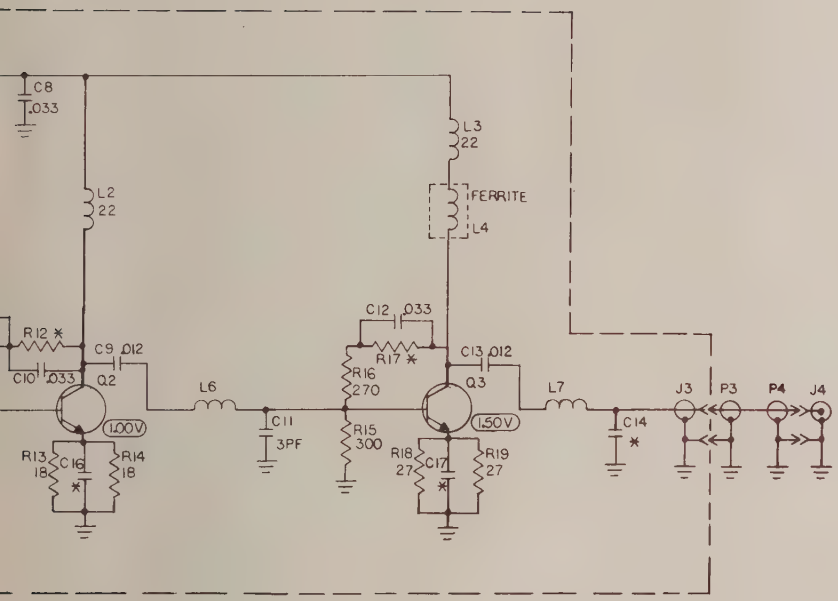
5.4 ORDERING REPLACEMENT PARTS

To obtain replacement parts, address order or inquiry to Electronic Navigation Industries, Inc. or its authorized service facility. Identify parts by number as listed in the parts list.



NOTES:

1. UNLESS OTHERWISE SPECIF
   A. ALL RESISTOR VALUES AR
   B. ALL CAPACITOR VALUES AR
   C. ALL INDUCTOR VALUES AR
2. VOLTAGE MEASUREMENTS TA
   APPLIED USING A VOLTMET
   IMPEDANCE. (10 MEG OR GR
3. * INDICATES VARIABLE VAL



FARADS.
OHENRIES.
NO SIGNAL
HIGH INPUT

Figure 5.1 Schematic Diagram

TABLE 5.1. REPLACEMENT PARTS LIST.

REF. DESIGN.	DESCRIPTION	MFR. CODE	PART NO.
	Power Distribution Assembly		
DS1	LED, Lamp	10226	5082-4430
T1	Transformer, Power	12715	AM6400A
Q1	Transistor	79089	40312
CR1	Bridge Rectifier	83003	VS148
C1	Cap., Elect., 500 UF 50 VDCW	09023	WBR500-50
S1	Switch, Toggle		ST1-1
S2	Switch, Slide DPDT	22753	622-HK-115/230
F1	Fuse Type 3AG, .5ASB	75915	313.500
FX	Fuseholder	75915	342001
A111	Power Supply Regulator Board	10226	600L-4822
A111IC1	I.C. Regulator	49956	RC723CT
A111C2	Cap., Mica, 560 PF 5%	09023	CM05ED561J03
A111R1	Resistor, Film, 2.7K ohm 5% 1/2W	16299	HC-5-2.7K
A111R2	Pot, 1K ohm, 5%	32997	3389T-1-102
A111R3	Resistor, Film, 2.7K ohm 5% 1/2W	16299	HC-5-2.7K
A111R4	Resistor, Comp., 1.2K ohm 5% 1/2W	01121	RC20GF122J
	RF Assembly		600L-2822
Q1-3	Transistor	10226	ENI-6
C1	Cap., Cer., 1PF, Chip	31433	C080C109D5GAH
C5	Cap., Feed Through, 1000 PF	72982	357-000X-540-102M
C6	Cap., Elect., 20 UF, 50VDCW	56289	TE1305
C15	Cap., Mica, 3 PF, 5%	09023	DM5CC030A
A-110	Power Amplifier Board	10226	600L-4821
A-110R1	Resistor, Comp., 27 ohm 5% 1/8W	01121	RC05GF270J
A-110R2,3	Resistor, Comp. 240 ohm 5% 1/8W	01121	RC05GF241J
A-110R4	Resistor, Comp. 300 ohm 5% 1/8W	01121	RC05GF301J
A-110R5	Resistor, Comp., 240 ohm 5% 1/4W	01121	RC07GF241J
A-110R6	Variable	01121	
A-110R7,8	Resistor, Comp., 18 ohm 5% 1/8W	01121	RC05GF180J
A-110R9	Resistor, Comp., 300 ohm 5% 1/8W	01121	RC05GF301J
A-110R10	Resistor, Comp., 200 ohm 5% 1/4W	01121	RC07GF201J
A-110R11	Resistor, Comp., 12 ohm 5% 1/4W	01121	RC07GF120J
A-110R12	Variable	01121	
A-110R13,14	Resistor, Comp., 18 ohm 5% 1/8W	01121	RC05GF180J
A-110R15	Resistor, Comp., 300 ohm 5% 1/8W	01121	RC05GF301J
A-110R16	Resistor, Comp., 270 ohm 5% 1/4W	01121	RC07GF271J
A-110R17	Variable	01121	
A-110R18,19	Resistor, Comp., 27 ohm 5% 1/8W	01121	RC05GF270J

A-110C2	Cap., Cer., .012 UF, Chip	32159	SC21BX123V
A-110C3	Cap., Cer., .033 UF, 50VDCW	72982	8121-050-651-333Z
A-110C4	Cap., Cer., .012 UF, Chip	32159	SC21BX123V
A-110C7,8	Cap., Cer., .033 UF, 50VDCW	72982	8121-050-651-333Z
A-110C9	Cap., Cer., .012, Chip	32159	SC21BX123V
A-110C10	Cap., Cer., .033 UF, 50 VDCW	72982	8121-050-651-333Z
A-110C11	Cap., Mica, 3PF, 5%	09023	DM5CC030A
A-110C12	Cap., Cer., .033 UF, 50 VDCW	72982	8121-050-651-333Z
A-110C13	Cap., Cer., .012 UF, Chip	32159	SC21BX123V
A-110L1-3	Choke, RF, 22 UH, 10%	99800	MS18130-24
A-110L4	Choke, RF	10226	

TABLE 5.2. GLOSSARY OF ABBREVIATIONS

AMP	AMPERES	PF	PICOFARAD
AMPL	AMPLIFIER	POT	POTENTIOMETER
BKT	BRACKET	REF	REFERENCE
CAP	CAPACITOR	RES	RESISTOR
CER	CERAMIC	SIL	SILICON
COMP	COMPOSITION CARBON	UF	MICROFARADS
DPDT	DOUBLE-POLE, DOUBLE THROW	UH	MICROHENRY
ELECT	ELECTROLYTIC	V	VOLTS
IN	INCHES	VAR	VARIABLE
K	KILOHMS	VDCW	DC WORKING VOLTS
MTG	MOUNTING	W	WATTS
MW	MILLIWATTS	WW	WIRE WOUND

TABLE 5.3. LIST OF MANUFACTURERS

FEDERAL SUPPLY CODE NUMBER	MANUFACTURER	ADDRESS
01121	Allen-Bradley Co.	Milwaukee, WI.
04713	Motorola, Inc. Semiconductor Prod. Div.	Phoenix, AZ.
09023	Cornell-Dubilier Electronics	Sanford, N.C.
10226	ELECTRONIC NAVIGATION INDUSTRIES, INC.	Rochester, N.Y.
12715	American Magnetics Corp.	Carterville, IL.
13511	Amphenol Corp., Inc.	Los Gatos, CA
14604	Elmwood Sensors, Inc.	Cranton, R.I.
16299	Corning Glass	Raleigh, N.C.
22753	U I D Electronics Corp.	Hollywood, FL.
32997	Bourns, Inc.	Riverside, CA.
49956	Raytheon Co.	Lexington, MA.
56289	Sprague Electric Co.	N. Adams, MA.
72982	Erie Technological Products, Inc.	Erie, PA.
75042	I R C Div. of TRW, Inc.	Philadelphia, PA.
75915	Littlefuse, Inc.	Des Plaines, IL.
79089	RCA	Harrison, N.Y.
99800	Delevan Electronics Corp.	E. Aurora, N.Y.
72619	Dialight Corp.	Brooklyn, N.Y.
28875	IMC Magnetics	Rochester, N.H.
32159	West-Cap Arizona	Tucson, AZ.
71590	Centralab Electronics	Milwaukee, WI.
83003	Varo, Inc.	Garland, TX.
87034	Marco Oak Industries	Anaheim, CA.
91293	Johanson Manufacturing Co.	Boonton, N.J.

FACTORY SERVICE

When Factory Service is required, the following steps should be taken:

(1) Notify ENI, giving full details of the difficulty. Include the instrument's serial number.

(2) Upon receipt of shipping instructions, forward the instrument, transportation prepaid to the factory or to the authorized repair station indicated on the instructions.

If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.